Azurophil Granules of Lymphocytes in Lactating Women; the Relation between Arakawa's Reaction and Azurophil Granules.

157th Report of the Peroxidase Reaction.
(104th Human Milk Study.)

By

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Introduction.

Hematological evidences that most of "healthy" mothers secreting human milk negative to Arakawa's reaction are in a state of avitaminosis B* have been forwarded in a number of papers from our Laboratory.

The prolongation of the short-timed peroxidase reaction of blood leucocytes was reported by Chiba and Abe¹⁾, Chiba²⁾, Suzuki³⁾⁴⁾, Suzuki and Shiraishi⁵⁾, and by myself⁶⁾; the platelet count by Kimura⁷⁾⁸⁾; the reticulocyte count by Shiraishi⁹⁾¹⁰⁾; neutrophils with pathological granules by Shindo¹¹⁾. Moreover, Kokubo (71st Report

* B means B₁ throughout the article.

- 1) M. Chiba and J. Abe, Tohoku J. Exp. Med., 1932, 19, 479.
- 2) M. Chiba, Ibid., 1932, 19, 486.
- 3) T. Suzuki, Ibid., 1934, 23, 23.
- 4) T. Suzuki, Ibid., 1935, 25, 186.
- 5) T. Suzuki and S. Shiraishi, Ibid., 1938, 34, 24.
- 6) S. Watanabe, Ibid., 1941, 40, 412.
- 7) J. Kimura, Ibid., 1934, 23, 494.
- 8) J. Kimura, Ibid., 1935, 28, 360.
- 9) S. Shiraishi, Ibid., 1937, 31, 268.
- 10) S. Shiraishi, Ibid., 1937, 31, 510.
- 11) M. Shindo, Ibid., 1939, 36, 361.

of the Peroxidase Reaction and 27th Hematological Paper)^{12) 13)} noticed from the general blood picture the difference between normal women and normal lactating mothers, and that of lactating mothers with Arakawa-positive and -negative milk. His conclusions are: The white cell picture of normal lactating women shows a slight nuclear shift to the left, and apparently healthy lactating women who are on the verge or already in a state of B-avitaminosis show leucocytosis resulting from neutrophiles as well as from lymphocytosis. Kokubo, however, did not study the azurophil granules in lymphocytes in his cases.

In the present paper I desire to report the difference of azurophil granules of lymphocytes in apparently healthy lactating women between Arakawa-positive and -negative cases.

Method of Experiment.

1. Materials. Apparently healthy lactating mothers of sick babies who visited our Pediatric Department of the Tohoku Imperial Hospital.

2. Blood taking. Blood was taken from ear lobes of apparently healthy lactating women when they were in a fasting state.

3. Blood examination. White cells were examined by use of Türk's solution. Blood films were made as thin as possible, lest red cells should be piled up. After these were air-dried they were fixed with methyl alcohol for five minutes and then stained with the Giemsa stain (Giemsa 3 gtt: Aq. dest. 1 c.c.) for 2 hours and washed thoroughly with running water.

Furukawa's¹⁴⁾ classification of lymphocytes was adopted.

a. Large lymphocytes are larger than neutrophiles.

b. Middle-sized lymphocytes are smaller than neutrophiles and larger than red cells.

c. Small lymphocytes are equal to the size of red cells or smaller than them.

After counting 200 lymphocytes, the cells with azurophil granules were shown in percentage of all the lymphocytes. At the same time, absolute count of lymphocytes was estimated after 200 white cells were counted.

4. Testing of Arakawa's reaction.

12) Y. Kokubo, Tohoku J. Exp. Med., 1936, 29, 373.

13) Y. Kokubo, Ibid., 1939, 35, 157.

14) H. Furukawa, Rinsho Byoriketsueki-gaku Zasshi, 1935, 4, 421.

Milk was examined with Arakawa's reagent. All cases were divided into three groups according to the intensity of Arakawa's reaction.

a. The normally or strongly Arakawa-positive group: Arakawa's reaction of milk from both breasts was normally or strongly positive in one minute.

b. The weakly Arakawa-positive group: Arakawa's reaction of milk was of intermediate strength.

c. Arakawa-negative group: Arakawa's reaction of milk from both breasts was completely or almost completely negative after five minutes.

The different courses of Arakawa's reaction during five minutes was shown by special signs (Cf. Table 1) for simplification.

TABLE 1.

Table of signs for showing different Arakawa's reaction.

		1'	2'	3'	4'	5'			1'	2'	3'	4'	5'
1.	1(##) stands for	##	##	##	##	##	25.	8(±) stands for	±	±	+	++	##
2.	1(++)	"	++	##	##	##	26.	9(±)	"	±	±	+	++
3.	2(++)	"	++	++	##	##	27.	10(±)	"	±	±	+	++
4.	3(++)	"	++	++	++	##	28.	11(±)	"	±	±	+	++
5.	4(++)	"	++	++	++	++	29.	12(±)	"	±	±	±	++
6.	5(++)	"	++	++	++	++	30.	13(±)	"	±	±	±	++
7.	1(+)	"	+	++	##	##	31.	14(±)	"	±	±	±	+
8.	2(+)	"	+	++	++	##	32.	15(±)	"	±	±	±	±
9.	3(+)	"	+	++	++	++	33.	1(-)	"	-	±	+	##
10.	4(+)	"	+	++	++	++	34.	2(-)	"	-	±	+	++
11.	5(+)	"	+	+	++	##	35.	3(-)	"	-	±	+	++
12.	6(+)	"	+	+	++	##	36.	4(-)	"	-	±	+	++
13.	7(+)	"	+	+	++	++	37.	5(-)	"	-	±	±	++
14.	8(+)	"	+	+	+	++	38.	6(-)	"	-	±	±	++
15.	9(+)	"	+	+	+	++	39.	7(-)	"	-	±	±	±
16.	10(+)	"	+	+	+	++	40.	8(-)	"	-	±	±	±
17.	11(+)	"	+	+	+	+	41.	9(-)	"	-	-	±	++
18.	1(±)	"	±	+	++	##	42.	10(-)	"	-	-	±	+
19.	2(±)	"	±	+	++	##	43.	11(-)	"	-	-	±	±
20.	3(±)	"	±	+	++	++	44.	12(-)	"	-	-	±	±
21.	4(±)	"	±	+	+	++	45.	13(-)	"	-	-	-	±
22.	5(±)	"	±	+	+	++	46.	14(-)	"	-	-	-	±
23.	6(±)	"	±	+	+	++	47.	15(-)	"	-	-	-	±
24.	7(±)	"	±	+	+	+	48.	16(-)	"	-	-	-	-

Explanation to the table:—

Take, for instance, the sign: 2(++). This stands for Arakawa's reaction with the course (++)1' (++)2' (##)3' (##)4' (##)5'. The sign does not express any prompt result of the reaction, so the prompt reaction of the sign: 2(++). may be (-)0', (±)0', (+)0' for even (++)0', but this will not matter much, as the result of the reaction in one minute is the most important. A normally Arakawa-positive milk is of the intensity (++) 1', (##) 2', (##) 3', (##) 4' and (##) 5'.

Results of Investigation.

I. Cases of healthy persons (Cf. Tables 2 and 3).

At first, 30 cases (mostly female) of healthy persons were investigated excluding such a case as showed a wide variation beyond the physiologic fluctuation in blood picture. As will be seen from Table 2, if the normal leucocyte count is assumed to lie between 5,000-7,000, then one will at once notice that all the cases show a normal count.

Lymphocytes with azurophil granules was 26.3% on an average, i.e., they were 21-25% in 12 cases, 26-30% in 15 cases and over 31% in 3 cases.

TABLE 2.
Cases of healthy males and (not lactating) women.

Case No.	Datum	Name	Sex	Age y = years	White blood cells per cumm.	Lym-phocytes		Lymphocytes with azurophil granules					Lymphocytes without azurophil granules				
						%	Absolute number	Large %	Middle-sized %	Small %	Total sum %	Absolute number	Large %	Middle-sized %	Small %	Total sum %	Absolute number
1	13. II	H.T.	♂	30 y	7,000	28	1,960	8.0	16.0	1.0	25.0	490	9.5	42.5	23.0	75.0	1,470
2	14. "	T.Y.	♂	30 y	6,500	25	1,625	8.0	17.0	2.0	27.0	439	25.0	40.0	8.0	73.0	1,186
3	17. "	K.A.	♀	18 y	7,000	28	2,160	13.5	14.5	1.0	29.0	626	10.0	54.5	6.5	71.0	1,534
4	18. "	C.I.	♀	18 y	6,700	33	2,211	9.5	14.0	0	23.5	519	14.5	56.0	6.0	76.5	1,692
5	20. "	K.W.	♀	21 y	6,900	26	1,794	10.5	13.0	1.5	25.0	448	15.0	48.0	12.0	75.0	1,346
6	21. "	T.S.	♀	20 y	7,700	40	3,080	13.0	12.0	0	25.0	764	15.5	52.5	7.0	75.0	2,316
7	22. "	Y.T.	♀	24 y	4,800	21	1,028	8.5	18.0	0	26.5	170	16.0	53.5	4.0	73.5	850
8	23. "	M.I.	♀	20 y	5,500	43	2,365	7.0	18.0	0.5	25.5	603	14.0	55.5	5.0	74.5	1,762
9	24. "	K.K.	♀	25 y	7,900	29	2,381	10.5	15.5	0	25.5	607	12.5	61.5	0.5	74.5	1,774
10	24. "	H.S.	♀	22 y	7,200	32	2,304	9.5	12.5	0.5	22.5	528	10.0	62.5	5.0	77.5	1,776
11	25. "	F.K.	♀	21 y	5,000	39	1,950	9.5	16.0	0.5	26.0	507	9.5	63.0	1.5	74.0	1,443
12	25. "	U.M.	♀	29 y	6,000	39	2,340	18.0	13.0	0	31.0	725	20.0	49.0	0	69.0	1,615
13	1. III	Y.T.	♀	18 y	6,500	20	1,300	9.0	22.0	0	31.0	403	10.0	56.0	3.0	69.0	897
14	6. "	M.T.	♀	20 y	7,300	31	2,263	9.0	14.0	0	23.0	520	12.5	59.0	5.5	57.0	1,743
15	7. "	N.K.	♀	19 y	7,400	38	2,812	4.0	27.0	0	31.0	872	7.5	59.0	2.5	69.0	1,940
16	7. "	N.T.	♀	19 y	8,700	45	3,915	10.0	14.0	0	24.0	940	13.5	62.0	0.5	76.0	2,975
17	17. "	T.T.	♀	20 y	7,300	24	1,752	12.5	12.5	0	25.0	438	15.0	59.0	1.0	75.0	1,314
18	20. "	K.M.	♀	18 y	6,900	45	3,105	7.5	16.5	0	24.0	445	9.0	64.0	3.0	76.0	2,660
19	22. "	M.S.	♀	20 y	6,100	26	1,586	9.5	12.5	0	22.0	349	11.0	61.5	5.5	78.0	1,237
20	25. "	H.T.	♀	20 y	7,300	26	1,898	8.0	17.5	0	25.5	424	9.5	65.0	0	74.5	1,474
21	12. IV	H.O.	♀	19 y	6,300	40	2,400	11.0	18.0	0	29.0	696	14.0	56.0	1.0	71.0	1,704
22	12. "	F.K.	♀	22 y	6,000	45	2,700	6.0	20.0	0	26.0	702	9.0	49.0	16.0	74.0	1,998
23	12. "	T.Y.	♀	21 y	7,100	44	3,124	10.0	16.0	0	26.0	812	17.0	51.0	6.0	74.0	2,312
24	13. "	M.N.	♂	31 y	7,100	43	3,053	9.0	21.0	0	30.0	916	10.0	57.5	3.0	70.0	2,137
25	17. "	I.H.	♂	30 y	5,900	48	2,832	4.5	22.0	0	26.5	750	7.0	62.0	4.0	73.5	2,082
26	28. VII	S.H.	♂	17 y	5,300	20	1,060	3.0	25.0	1.0	29.0	307	8.0	54.0	9.0	71.0	753
27	28. "	N.T.	♀	18 y	7,700	45	3,465	6.0	18.0	0	24.0	624	9.0	65.0	2.0	76.0	2,841
28	28. "	K.S.	♀	18 y	5,700	45	2,565	10.0	16.0	0	26.0	667	13.0	61.0	0	74.0	1,898
29	29. "	C.T.	♀	20 y	5,400	24	1,296	12.0	12.0	1.0	25.0	324	14.0	57.0	4.0	75.0	972
30	29. "	K.W.	♀	18 y	6,300	45	3,135	6.0	23.0	0	29.0	909	10.0	60.0	1.0	71.0	2,226
Average					6,200		2,207				26.3	564					
Maximum					8,700		3,915				31.0	940					
Minimum					4,800		1,028				22.0	170					

TABLE 3.
Lymphocytes with azurophil granules in lactating women with different Arakawa's reaction.

		Lymphocytes with azurophil granules (%)			Cases
		Maximum (%)	Minimum (%)	Average (%)	
Healthy persons (mostly adults, lactating women excepted)		31.0	22.0	26.3	30
Arakawa's reaction	Positive cases	37.0	28.0	30.5	68
	Intermediate cases	24.0	15.0	19.0	100
	Negative cases	18.0	10.0	14.6	33

Absolute count of lymphocytes with azurophil granules was 564 on an average and 900-200 cells per cmm. can be assumed as normal limits.

II. Cases of lactating women (Cf. Table 4, 5 and 6).

All the 201 cases were divided into three groups according to the intensity of Arakawa's reaction. In my investigation there were 68 cases of the normally or strongly Arakawa-positive group, 100 cases of the weakly positive group, and 33 cases of the completely or almost completely negative group.

TABLE 4.
Cases of the normally or strongly Arakawa-positive group.

Case No.	Datum	Name	Age (y=years)	Arakawa's reaction		White blood cells per cmm.	Lymphocytes		Lymphocytes with azurophil granules					Lymphocytes without azurophil granules				
				Right	Left		%	Absolute number	Large %	Middle-sized %	Small %	Total sum %	Absolute number	Large %	Middle-sized %	Small %	Total sum %	Absolute
1	15. II	K.W.	26 y	1(++)	2(++)	8,900	29	2,581	10.0	17.0	2.0	29.0	748	13.0	54.0	4.0	71.0	1,8
2	23. "	K.H.	35 y	2(++)	5(++)	6,400	31	2,432	14.5	16.5	0	31.0	754	20.5	52.0	1.5	69.0	1,6
3	18. III	K.S.	26 y	3(++)	4(++)	5,900	27	1,593	11.5	17.0	0	28.5	453	11.0	55.5	5.0	71.5	1,1
4	25. "	S.H.	39 y	3(++)	2(++)	8,000	37	2,960	8.0	20.0	0	28.0	829	8.0	59.0	5.0	72.5	2,1
5	11. IV	T.O.	26 y	3(++)	1(++)	5,800	23	1,334	6.0	23.0	0	29.0	387	8.0	61.0	2.0	71.0	9
6	28. "	N.N.	18 y	5(++)	2(++)	10,500	29	3,045	5.0	25.0	0	30.0	913	7.0	56.0	7.0	70.0	2,1
7	1. V	T.Y.	26 y	3(++)	5(++)	8,100	38	3,078	5.0	24.0	0	29.0	892	8.0	61.5	1.5	71.0	2,1
8	9. "	A.M.	25 y	1(++)	1(++)	5,500	31	1,705	7.0	22.0	0	29.0	494	8.0	61.5	1.5	71.0	1,2
9	9. "	T.T.	30 y	1(++)	3(++)	5,700	15	855	6.0	22.0	1.0	29.0	248	7.0	62.0	2.0	71.0	6
10	10. "	F.S.	27 y	3(++)	2(++)	5,000	33	1,650	3.0	24.0	2.0	29.0	478	4.0	58.0	9.0	71.0	1,1
11	10. "	T.K.	23 y	1(++)	2(++)	8,200	59	4,833	3.0	27.0	0	30.0	1,451	5.0	62.0	2.5	70.0	3,3
12	10. "	T.S.	25 y	5(++)	1(++)	6,500	18	1,170	10.0	18.0	0	28.0	328	11.0	60.0	1.0	72.0	8
13	11. "	K.Y.	41 y	1(++)	1(++)	5,000	39	1,900	9.0	19.0	0	28.0	546	15.0	66.0	1.0	72.0	1,4
14	11. "	K.N.	40 y	3(++)	5(++)	5,300	49	2,597	8.0	27.0	0	35.0	898	12.0	53.0	0	65.0	1,6
15	22. "	S.O.	35 y	2(++)	2(++)	6,600	29	1,914	5.5	24.0	0	29.5	565	8.0	62.0	0.5	70.5	1,3

TABLE 4. (Continued.)

Datum	Name	Age (y=years)	Arakawa's reaction		White blood cells per cmm.	Lym-phocytes		Lymphocytes with azurophil granules					Lymphocytes without azurophil granules					Remarks
			Right	Left		%	Absolute number	Large %	Middle-sized %	Small %	Total sum %	Absolute number	Large %	Middle-sized %	Small %	Total sum %	Absolute number	
12. V	M.E.	34 y	3(++)	1(++)	9,700	30	2,910	5.5	23.5	0	29.0	844	7.5	63.0	0.5	71.0	2,066	
12. "	T.S.	37 y	3(++)	1(++)	5,000	45	2,750	6.5	23.0	0	29.5	811	9.5	57.0	4.0	70.5	1,939	
12. "	T.H.	23 y	1(++)	1(++)	8,300	37	3,071	2.0	31.5	0.5	34.0	1,044	5.0	55.0	6.0	66.0	2,027	
12. "	T.T.	25 y	2(++)	1(++)	10,400	39	4,056	7.0	29.0	0	36.0	1,460	10.0	53.0	1.0	64.0	2,596	
13. "	T.T.	27 y	1(++)	1(++)	11,100	43	4,773	6.0	28.0	1.0	35.0	1,670	8.0	51.0	6.0	65.0	3,103	
14. "	H.N.	22 y	1(++)	1(++)	9,700	49	4,553	2.0	29.0	1.0	32.0	1,457	3.0	54.0	11.0	68.0	3,096	
14. "	S.E.	38 y	1(++)	3(++)	7,400	66	4,884	3.5	23.5	1.5	28.5	1,398	7.0	60.0	4.5	71.5	3,486	
15. "	K.S.	26 y	1(++)	1(++)	6,300	34	2,142	9.0	20.0	0	29.0	621	15.0	51.0	5.0	71.0	1,521	
16. "	T.O.	26 y	1(++)	1(++)	6,800	32	2,076	3.0	28.0	1.0	32.0	664	6.0	57.0	5.0	68.0	1,412	
18. "	Y.U.	26 y	1(++)	1(++)	6,300	30	1,890	6.0	23.0	0	29.0	548	9.0	57.0	5.0	71.0	1,342	
19. "	K.Y.	26 y	1(++)	1(++)	6,300	50	3,150	5.0	28.5	0	33.5	1,055	6.0	58.5	2.0	66.5	2,095	
20. "	Y.A.	25 y	1(++)	1(++)	5,800	24	1,392	5.5	24.0	0.5	30.0	418	9.0	53.5	7.5	70.0	974	
21. "	M.T.	22 y	1(++)	1(++)	8,900	34	3,026	3.0	27.0	0	30.0	909	8.0	54.0	8.0	70.0	2,117	
22. "	K.S.	27 y	3(++)	3(++)	5,600	37	2,072	7.0	27.5	0	34.5	715	7.5	54.5	3.5	65.5	1,357	
22. "	K.Y.	27 y	1(++)	2(++)	7,000	24	1,680	6.0	23.0	0	29.0	487	15.0	51.0	5.0	71.5	1,193	
23. "	S.M.	28 y	1(++)	1(++)	8,400	42	3,528	4.0	26.0	0	30.0	1,058	6.0	62.0	2.0	70.0	2,470	
24. "	H.O.	26 y	2(++)	2(++)	10,000	23	2,300	7.0	21.0	0	28.0	644	11.0	60.0	1.0	72.0	1,556	
24. "	F.E.	33 y	2(++)	5(++)	6,200	17	1,054	9.5	18.5	1.0	29.0	306	12.0	59.0	10.0	71.0	748	
25. "	K.I.	31 y	1(++)	1(++)	7,600	63	4,788	9.0	26.0	0	35.0	1,876	11.5	51.0	2.5	65.0	3,112	
25. "	T.H.	26 y	2(++)	1(++)	9,200	23	2,116	6.0	30.0	1.0	37.0	783	9.0	52.0	2.0	63.0	1,333	
25. "	A.K.	32 y	1(++)	1(++)	5,700	59	3,363	18.0	12.0	2.0	22.0	1,076	21.0	44.0	3.0	68.0	2,287	
13. VI	K.Y.	26 y	2(++)	2(++)	5,900	56	3,304	2.0	28.0	0.5	30.5	1,008	4.0	61.5	3.5	69.5	2,296	
15. "	C.N.	31 y	5(++)	1(++)	8,900	32	1,848	3.5	25.0	0.5	29.0	536	5.0	65.5	9.5	71.0	1,132	
20. "	T.F.	25 y	1(++)	1(++)	8,000	35	2,800	6.0	26.0	0	32.0	896	11.0	57.0	0	68.0	1,904	
20. "	H.K.	34 y	1(++)	1(++)	5,300	35	1,885	4.0	28.0	0	32.0	594	8.0	57.0	3.0	68.0	1,261	§
26. "	H.C.	36 y	3(++)	1(++)	9,300	29	2,697	7.0	25.0	0	32.0	863	11.0	57.0	0	68.0	1,834	
26. "	S.I.	37 y	1(++)	4(++)	6,700	31	2,077	8.0	22.0	0	30.0	623	12.0	55.0	3.0	70.0	1,354	
8. VII	M.S.	25 y	5(++)	1(++)	8,300	38	3,154	4.0	25.0	0	29.0	915	8.0	58.0	5.0	71.0	2,239	
8. "	S.S.	27 y	5(++)	2(++)	7,000	29	2,030	8.0	20.0	0	28.0	568	9.0	53.0	10.0	72.0	1,462	
8. "	M.S.	25 y	1(++)	1(++)	7,300	34	2,482	4.0	26.0	1.0	31.0	769	6.0	53.0	10.0	69.0	1,713	
12. "	Y.Y.	28 y	1(++)	3(++)	6,600	35	2,310	8.5	19.5	0	28.0	647	11.0	59.0	2.0	72.0	1,663	
13. "	T.T.	26 y	2(++)	1(++)	6,500	62	4,030	10.5	17.5	0	28.0	1,128	13.5	56.0	2.5	72.0	3,902	§
13. "	H.F.	24 y	1(++)	1(++)	7,000	34	2,380	9.5	22.5	0	32.0	762	11.5	58.0	3.5	68.0	1,618	
14. "	M.O.	21 y	1(++)	1(++)	7,000	37	2,590	11.0	16.0	1.0	28.0	725	12.0	46.0	4.0	72.0	1,865	
14. "	K.T.	26 y	2(++)	2(++)	5,400	37	1,998	5.5	25.5	0	31.0	619	10.0	56.0	3.0	69.0	1,379	
20. "	S.H.	29 y	1(++)	1(++)	7,000	34	2,380	5.0	30.0	0.5	35.5	845	8.0	52.0	4.5	64.5	1,535	
27. "	K.S.	30 y	2(++)	1(++)	10,700	36	3,852	2.5	31.0	0.5	34.0	1,310	5.0	56.0	5.0	66.0	2,542	
27. "	K.F.	41 y	1(++)	1(++)	6,800	41	2,788	11.0	23.0	0	34.0	950	14.0	52.0	0	66.0	1,838	
28. "	T.Y.	36 y	1(++)	1(++)	9,000	42	3,780	6.0	24.0	0	30.0	1,134	13.0	54.0	3.0	70.0	2,646	
28. "	M.O.	28 y	1(++)	1(++)	8,100	16	1,296	12.0	20.0	0	32.0	415	18.0	49.0	1.0	68.0	881	
21. "	C.A.	37 y	1(++)	1()	7,600	40	3,040	6.0	21.0	1.5	28.5	866	7.0	60.0	4.5	71.5	2,174	
28. "	T.S.	32 y	1()	1()	7,500	41	3,075	9.0	23.0	0	32.0	984	12.0	53.0	3.0	68.0	2,091	
5. IX	K.S.	26 y	1()	1()	6,800	23	1,564	6.0	22.0	0	28.0	438	9.0	58.0	5.0	72.0	1,126	
5. "	H.M.	34 y	1(++)	1(++)	5,700	44	2,618	5.0	23.0	0	28.0	733	7.0	63.0	2.0	72.0	1,885	
6. "	T.H.	28 y	1()	3()	8,500	30	2,550	12.0	16.0	0	28.0	714	14.0	55.0	3.0	72.0	1,836	
11. "	F.K.	35 y	1(++)	1(++)	5,900	28	1,652	6.0	21.0	2.0	29.0	479	13.0	53.0	5.0	71.0	1,173	
18. "	H.K.	23 y	2(++)	4(++)	5,400	39	2,106	4.0	24.0	0	28.0	590	6.0	63.0	3.0	72.0	1,616	
21. "	M.S.	25 y	5(++)	1(++)	7,500	47	3,525	6.0	25.0	1.0	32.0	1,128	8.0	55.0	5.0	68.0	2,397	

TABLE 4. (Continued.)

Case No.	Datum	Name	Age (y=years)	Arakawa's reaction		White blood cells per cmm.	Lymphocytes		Lymphocytes with azurophil granules					Lymphocytes without azurophil granules				
				Right	Left		%	Absolute number	Large %	Middle-sized %	Small %	Total sum %	Absolute number	Large %	Middle-sized %	Small %	Total sum %	Absolute number
64	29. "	M.R.	28 y	2(++)	1(++)	6,200	25	1,550	12.0	15.0	0	27.0	418	16.0	57.0	0	73.0	1,33
65	2. X	O.K.	29 y	1(++)	1(++)	6,600	32	2,112	7.5	24.0	0.5	32.0	676	11.5	50.5	6.0	68.0	1,43
66	10. "	A.K.	22 y	5(++)	2(++)	6,100	30	1,830	4.0	25.5	1.0	30.0	649	9.0	58.0	5.0	70.0	1,28
67	10. "	A.A.	27 y	1(++)	1(++)	7,000	45	3,150	10.0	19.0	1.0	30.0	945	10.0	53.0	7.0	70.0	1,20
68	17. "	K.K.	30 y	1(++)	1(++)	6,600	30	1,980	7.0	24.5	0.5	31.5	633	11.5	56.0	1.0	68.0	1,34
Average						7,300		2,582				30.5	793					
Maximum						11,100		4,883				37.0	1,670					
Minimum						5,000		855				28.0	248					

§ Mother has been taking vitamin B.

TABLE 5.

Cases of the Arakawa-negative group (or the weakly Arakawa-positive group).

1	15. II	S.S.	26 y	13(±)	10(+)	6,800	17	1,156	4.0	13.5	1.5	19.0	220	8.5	59.5	13.0	81.0	93
2	17. "	T.M.	37 y	4(±)	9(+)	8,200	26	2,132	15.0	6.0	1.0	22.0	469	23.0	53.0	2.0	78.0	1,63
3	18. "	C.T.	33 y	5(+)	15(-)	6,500	35	2,175	5.0	10.0	1.0	16.0	338	10.5	67.5	6.0	84.0	1,83
4	22. "	T.M.	31 y	7(±)	7(+)	7,100	58	4,118	13.5	4.5	0	18.0	741	24.5	56.0	1.5	88.0	2,36
5	22. "	T.O.	27 y	12(-)	8(+)	5,300	29	1,537	6.5	8.5	0	15.0	230	12.0	66.0	2.0	85.0	1,30
6	2. III	K.K.	38 y	11(±)	11(+)	8,900	38	3,382	5.0	10.0	0	15.0	507	12.0	68.0	5.0	85.0	2,87
7	2. "	T.F.	22 y	11(+)	8(-)	7,600	37	2,112	10.5	12.0	0	22.5	633	13.5	62.0	2.0	77.5	1,17
8	6. "	K.K.	31 y	11(±)	12(-)	7,200	18	1,296	6.5	11.5	0	18.0	233	13.5	66.5	2.0	82.0	1,06
9	8. "	K.S.	21 y	7(+)	7(+)	11,000	13	1,430	5.5	9.0	0	14.5	208	9.0	75.0	1.5	85.5	1,22
10	8. "	T.A.	26 y	7(±)	7(±)	7,200	35	2,520	10.5	8.0	0	18.5	466	12.5	68.0	1.0	81.5	2,05
11	13. "	C.O.	28 y	11(±)	10(+)	9,500	35	3,325	8.0	14.5	0	22.5	748	12.5	60.5	4.5	77.5	2,57
12	14. "	K.S.	30 y	6(-)	6(-)	7,100	30	2,100	6.0	13.0	0	19.0	405	8.5	64.5	8.0	81.0	1,72
13	16. "	A.F.	28 y	11(±)	15(-)	8,000	24	1,920	5.0	11.0	0	16.0	307	8.5	74.0	1.5	84.0	1,51
14	20. "	A.F.	25 y	9(+)	9(+)	10,200	40	4,080	4.5	15.0	0	19.5	796	5.0	68.0	7.5	80.5	3,28
15	27. "	T.T.	26 y	11(+)	5(±)	6,400	32	2,048	9.0	10.0	0	19.0	389	14.5	64.5	2.0	81.0	1,65
16	27. "	T.D.	35 y	6(-)	6(-)	5,800	36	2,088	6.5	10.0	0	16.5	344	12.5	69.5	1.5	83.5	1,74
17	29. "	K.D.	31 y	7(±)	14(±)	5,800	47	2,726	9.5	8.0	0.5	18.0	491	11.0	66.0	5.0	82.0	2,23
18	31. "	K.S.	22 y	8(-)	3(±)	7,100	31	2,201	2.0	15.0	0	17.0	374	7.0	68.0	8.0	83.0	1,82
19	5. IV	F.O.	30 y	11(±)	13(±)	9,200	15	1,380	10.0	11.0	0	21.0	290	16.0	63.0	0	79.0	1,08
20	10. "	C.C.	35 y	4(-)	16(-)	11,700	42	4,914	4.0	11.0	0	15.0	737	8.0	74.0	3.0	85.0	4,17
21	17. "	L.C.	24 y	7(±)	7(±)	9,100	21	1,911	4.5	14.5	1.0	20.0	382	10.5	57.5	12.0	80.0	1,52
22	19. "	F.O.	28 y	7(±)	1(±)	8,600	42	3,612	7.0	17.0	0	24.0	867	9.5	58.0	8.5	76.0	1,74
23	20. "	C.C.	30 y	1(+)	16(-)	10,100	29	2,929	11.0	8.0	0	19.0	556	77.0	64.0	0	81.0	2,37
24	21. "	T.O.	30 y	8(-)	1(±)	4,700	49	2,303	3.0	20.0	0	23.0	530	8.0	62.0	7.0	77.0	1,77
25	10. V	F.E.	41 y	9(+)	13(±)	8,400	30	2,530	7.0	9.0	0	16.0	403	12.0	67.0	5.0	84.0	2,11
26	10. "	K.O.	24 y	10(+)	14(±)	4,100	32	2,272	3.6	15.5	0	19.0	432	5.5	68.0	7.5	81.0	1,84
27	12. "	O.K.	30 y	11(±)	7(±)	5,400	42	2,268	2.0	20.0	0	22.0	499	5.0	71.0	2.0	78.0	1,76
28	12. VI	A.S.	30 y	3(+)	3(+)	6,800	45	3,060	7.0	10.0	0	17.0	520	11.0	71.0	1.0	83.0	2,54
29	20. "	T.L.	33 y	5(±)	4(-)	7,300	47	3,438	4.0	11.0	0	15.0	515	8.0	34.0	3.0	85.0	2,91
30	23. "	S.A.	34 y	3(±)	3(±)	9,000	38	3,427	1.0	16.0	0	17.0	582	5.0	78.0	5.0	83.0	2,84
31	26. "	T.S.	26 y	7(-)	7(±)	7,400	41	3,034	3.0	14.0	0	17.0	516	5.0	72.0	6.0	83.0	2,51
32	3. "	A.S.	26 y	6(+)	9(+)	6,100	44	2,684	7.0	15.0	1.0	22.0	590	13.0	64.0	1.0	78.0	2,04
33	4. "	K.F.	25 y	6(±)	3(+)	9,200	28	2,392	5.0	13.0	0	18.0	430	11.0	70.0	1.0	82.0	1,84
34	6. "	L.O.	25 y	5(±)	1(+)	7,500	23	1,725	3.5	14.0	0	17.5	302	10.0	61.5	6.0	82.5	1,45
35	6. "	O.F.	22 y	7(±)	3(±)	10,000	41	4,100	7.0	13.0	0	17.0	697	12.5	67.0	0.5	83.5	3,40

TABLE 5. (Continued.)

Datum	Name	Age (y=years)	Arakawa's reaction		White blood cells per cmm.	Lym- phocytes		Lymphocytes with azurophil granules					Lymphocytes without azurophil granules					Remarks
			Right	Left		%	Absolute number	Large %	Middle- sized %	Small %	Total sum %	Absolute number	Large %	Middle- sized %	Small %	Total sum %	Absolute number	
7. VII	F.T.	22 y	7(±)	13(±)	8,600	65	5,590	7.5	13.5	1.0	22.0	1,230	13.5	59.5	5.0	78.0	4,370	
12. "	T.F.	24 y	14 -	11(+)	8,500	33	2,805	6.5	16.5	0	23.0	645	9.5	61.5	3.5	77.0	2,160	
13. "	A.S.	31 y	55(+)	1(+)	6,400	54	3,556	5.0	14.0	0	19.0	676	9.0	69.0	3.0	81.0	2,880	
17. "	A.F.	34 y	22(+)	2(+)	5,500	40	2,200	6.0	18.0	0	24.0	528	9.0	64.0	3.0	76.0	1,672	
19. "	K.K.	26 y	11(±)	11(±)	7,400	30	2,220	9.0	13.0	0	22.0	488	17.0	61.0	0	78.0	1,732	
20. "	A.S.	30 y	4(+)	2(++)	5,100	50	2,550	3.0	14.5	1.0	18.2	472	4.5	77.5	10.0	81.5	2,078	
28. "	A.K.	34 y	3(±)	3(+)	7,800	22	1,716	5.0	16.0	0	21.0	360	15.0	60.0	4.0	79.0	1,456	
14. VIII	K.W.	39 y	1(+)	1(+)	8,100	34	2,754	4.0	14.0	6.0	19.0	522	7.0	72.0	2.0	81.0	2,252	
14. "	K.O.	30 y	7(+)	5(++)	10,000	36	3,600	5.0	16.0	0	21.0	756	10.0	64.0	3.0	79.0	2,844	
15. "	K.F.	27 y	3(+)	5(+)	10,500	34	3,570	5.0	18.0	0	23.0	821	11.0	63.0	3.0	77.0	2,749	
15. "	S.S.	34 y	5(++)	4(+)	8,500	13	1,105	4.0	14.0	1.0	19.0	210	9.0	67.0	8.0	81.0	895	
17. "	C.K.	35 y	4(+)	5(++)	10,300	33	3,399	9.0	11.0	0	20.0	680	13.0	66.0	1.0	80.0	2,919	
17. "	S.O.	25 y	7(+)	11(±)	8,000	35	2,800	3.0	16.0	0	19.0	532	10.0	67.0	4.0	81.0	2,268	
18. "	K.W.	20 y	4(-)	2(++)	9,800	25	2,450	4.0	13.0	0	17.0	416	7.0	75.0	1.0	83.0	2,034	
21. "	T.S.	40 y	1(++)	7(+)	9,100	32	2,912	2.0	16.0	0	18.0	524	6.0	72.0	4.0	82.0	2,388	
22. "	A.S.	25 y	7(+)	1(++)	5,700	31	1,767	6.5	12.0	0	18.5	327	14.5	65.0	2.0	81.5	1,440	
22. "	T.S.	42 y	7(+)		6,700	38	2,546	2.0	16.0	1.0	19.0	484	12.5	66.0	3.0	81.0	2,062	
23. "	K.T.	24 y	2(++)	5(±)	7,800	18	1,404	2.0	16.0	0	18.0	253	6.0	73.0	3.0	82.0	1,151	
28. "	F.M.	29 y	4(+)	3(±)	6,600	44	2,904	3.0	16.0	0	19.0	552	10.0	63.0	8.0	81.0	2,352	
1. IX	E.E.	26 y	2(++)	9(+)	7,000	47	3,290	3.0	16.0	0	19.0	625	8.0	64.0	9.0	81.0	2,665	
1. "	K.F.	28 y	7(+)	6(+)	5,800	36	2,088	4.0	15.0	0	19.0	397	10.0	68.0	3.0	81.0	1,691	
4. "	C.K.	33 y	6(±)	4(+)	7,600	28	2,128	4.0	14.0	0	18.0	383	9.0	69.0	4.0	86.0	1,545	
4. "	T.T.	26 y	7(+)	3(±)	9,100	37	3,336	7.0	16.0	0	23.0	774	13.0	62.0	2.0	77.0	2,593	
5. "	A.F.	29 y	1(++)	16(-)	7,300	35	2,555	8.0	10.0	0	18.0	460	14.0	66.0	2.0	82.0	1,895	
5. "	C.F.	35 y	1(++)	1(+)	8,000	36	2,880	6.0	15.0	0	21.0	606	12.0	65.0	2.0	79.0	2,174	
5. "	K.S.	28 y	13(±)	11(+)	5,900	29	1,711	4.0	15.0	1.0	20.0	342	7.0	68.0	5.0	80.0	1,869	
6. "	C.F.	30 y	7(±)	4(+)	7,200	31	2,232	7.0	11.0	0	18.0	410	9.0	71.0	2.0	82.0	1,822	
6. "	H.K.	28 y	5(++)	4(±)	7,200	21	1,512	6.0	11.0	0	17.0	257	14.0	65.0	4.0	83.0	1,255	
7. "	A.K.	30 y	10(+)	11(±)	6,300	45	2,336	13.0	8.0	0	21.0	595	13.0	65.0	1.0	79.0	2,240	
9. "	T.S.	30 y	1(++)	2(+)	8,300	35	2,905	7.0	12.0	1.0	20.0	581	9.0	62.0	9.0	80.0	3,324	
9. "	N.K.	31 y	3(+)	2(++)	11,000	16	1,760	7.0	14.0	0	21.0	370	13.0	61.0	5.0	79.0	1,390	
11. "	N.E.	34 y	4(+)	2(+)	7,100	48	3,408	9.0	18.0	0	17.0	570	15.0	66.0	2.0	83.0	2,829	
11. "	K.K.	35 y	4(+)	7 -	7,200	26	1,872	4.5	12.0	0	16.5	309	10.5	71.5	1.5	83.0	1,565	
12. "	T.S.	23 y	6(±)	4(+)	6,100	38	2,318	2.0	16.0	0	18.0	417	8.0	70.0	4.0	82.0	1,901	
12. "	M.S.	28 y	5(±)	2(+)	10,000	27	2,700	3.0	15.0	0	18.0	486	8.0	69.0	5.0	82.0	2,214	
12. "	E.K.	28 y	2(+)	12(-)	6,500	37	2,405	9.0	9.0	0	18.0	433	16.0	64.0	2.0	82.0	1,972	
18. "	K.K.	23 y	9(+)	9(+)	7,800	35	2,730	4.0	16.5	0.5	21.0	573	10.0	64.0	5.0	79.0	2,157	
20. "	K.O.	21 y	16(-)	11(+)	8,800	35	3,080	3.0	13.0	1.0	17.0	524	4.0	70.0	9.0	83.0	2,556	
20. "	A.W.	26 y	9(+)	7(±)	8,600	44	3,344	1.0	14.0	0	15.0	502	4.0	73.0	8.0	85.0	2,842	
25. "	K.K.	32 y	7(+)	7(+)	7,200	31	2,234	6.0	16.0	0	22.0	491	11.0	63.0	4.0	78.0	1,743	\$
25. "	U.H.	37 y	3(±)	7(+)	5,900	51	3,009	2.0	19.0	0	21.0	632	12.0	66.0	1.0	79.0	2,377	
25. "	P.E.	32 y	2(++)	7(+)	7,800	24	1,872	7.0	11.0	0	18.0	337	12.0	66.0	4.0	82.0	1,535	
27. "	O.F.	34 y	1(++)	9(+)	10,300	30	3,090	12.0	10.0	0	22.0	680	16.0	60.0	2.0	78.0	2,410	
27. "	H.U.	28 y	1(+)	8(-)	6,800	30	2,040	7.0	11.0	0	18.0	367	11.0	69.0	2.0	82.0	1,673	
27. "	K.F.	26 y	2(++)	4(+)	7,200	31	2,232	7.0	13.0	0	20.0	446	12.0	67.0	1.0	80.0	1,786	
27. "	A.W.	29 y	7(±)	7 -	8,600	39	3,357	6.5	11.5	0	18.0	604	10.5	62.5	9.0	82.0	2,753	\$
28. "	A.H.	29 y	2(+)	7(-)	8,700	34	2,958	6.0	11.0	0	17.0	503	9.0	70.0	4.0	83.0	2,455	
28. "	K.W.	31 y	4 -	9 -	5,800	46	2,576	2.0	15.0	0	17.0	438	11.0	65.0	7.0	83.0	2,138	

TABLE 5. (Continued.)

Case No.	Datum	Name	Age (y = years)	Arakawa's reaction		White blood cells per cmm.	Lymphocytes		Lymphocytes with azurophil granules					Lymphocytes without azurophil granules				
				Right	Left		%	Absolute number	Large %	Middle-sized %	Small %	Total sum %	Absolute number	Large %	Middle-sized %	Small %	Total sum %	Absolute number
84	29. IX	K.O.	21 y	3(±)	7(+)	7,000	25	1,750	6.0	15.0	0	21.0	367	13.0	62.0	4.0	79.0	1,388
85	2. X	A.K.	27 y	8(-)	4(-)	7,800	42	3,276	8.0	12.0	0	20.0	655	15.0	64.0	1.0	80.0	2,621
86	2. "	K.N.	33 y	4(-)	4(-)	8,600	52	4,472	10.0	12.0	0	22.0	984	22.0	56.0	0	78.0	3,486
87	3. "	S.S.	32 y	1(±)	5(±)	8,800	16	1,408	7.0	10.0	0	17.0	239	11.0	66.0	6.0	82.0	2,169
88	3. "	A.K.	29 y	7(+)	7(+)	6,700	66	4,422	5.0	12.0	0	17.0	752	13.0	69.0	1.0	83.0	3,670
89	4. "	T.K.	28 y	1(+)	1(+)	7,000	24	1,680	9.0	11.0	0	20.0	336	17.0	62.0	1.0	80.0	1,344
90	4. "	P.U.	27 y	8(+)	3(±)	6,800	49	3,332	4.0	18.0	0	22.0	732	11.0	66.0	1.0	78.0	2,599
91	5. "	T.K.	28 y	11(-)	11(±)	7,200	27	1,944	7.0	11.0	0	18.0	350	9.0	69.0	4.0	82.0	1,594
92	5. "	S.K.	30 y	1(±)	4(-)	8,000	44	3,520	6.0	13.0	0	19.0	669	19.0	62.0	0	81.0	1,851
93	10. "	S.H.	20 y	6(±)	6(±)	7,000	40	2,800	3.0	15.0	0	18.0	504	8.0	68.0	6.0	82.0	2,296
94	11. "	K.A.	30 y	4(-)	4(+)	8,000	50	4,000	9.0	13.0	0	22.0	880	20.0	58.0	0	78.0	3,120
95	11. "	A.K.	28 y	7(-)	4(±)	7,000	42	2,940	7.0	13.0	0	20.0	588	14.0	65.0	1.0	80.0	2,352
96	13. "	K.K.	20 y	4(+)	9(+)	7,000	24	9,680	8.0	12.0	1.0	21.0	353	18.0	62.0	1.0	79.0	1,327
97	13. "	A.U.	23 y	4(+)	3(±)	6,000	40	2,400	4.0	17.0	1.0	22.0	528	10.0	67.0	1.0	78.0	1,872
98	14. "	K.K.	30 y	11(-)	7(±)	7,200	27	1,944	7.0	11.0	0	18.0	350	8.0	70.0	4.0	82.0	1,594
99	16. "	A.T.	28 y	7(±)	10(±)	7,000	40	2,800	3.0	15.0	0	18.0	504	3.0	69.0	6.0	82.0	2,296
100	18. "	T.K.	31 y	7(±)	13(±)	5,000	53	2,650	6.0	11.0	0	17.0	450	11.0	65.0	7.0	83.0	2,200
Average						7,600		2,682				19.0	506					
Maximum						11,000		5,590				24.0	1,236					
Minimum						4,700		1,105				15.0	220					

§ Cf. Foot-note to Table 4.

TABLE 6.

Cases of the Arakawa-negative group (or the completely Arakawa-negative group).

1	16. II	H.T.	26 y	12(-)	12(-)	6,400	25	1,600	6.0	10.0	1.0	17.0	272	22.5	56.5	14.0	83.0	1,328
2	27. "	M.T.	35 y	8(-)	8(-)	7,900	26	2,054	6.0	7.5	0.5	14.0	349	8.0	71.0	7.0	86.0	1,705
3	27. "	M.T.	30 y	16(-)	16(-)	8,500	32	2,720	8.0	9.5	0.5	18.0	490	16.5	61.0	4.5	82.0	2,230
4	28. "	Y.S.	28 y	15(-)	15(-)	10,000	27	2,700	8.5	5.0	0	13.0	364	19.5	66.5	0.5	86.5	2,336
5	1. III	M.I.	32 y	14(-)	15(-)	8,800	29	2,552	7.0	9.0	0	16.0	408	16.0	55.0	13.0	84.0	2,144
6	2. "	M.S.	30 y	16(-)	16(-)	10,500	18	1,890	3.5	11.0	0	14.5	264	10.0	70.5	5.0	85.5	1,626
7	18. "	T.O.	25 y	15(-)	15(-)	9,000	20	1,800	6.0	11.0	0	17.0	306	16.0	72.0	5.0	83.0	1,494
8	17. IV	F.K.	35 y	8(-)	15(-)	8,400	41	3,444	11.0	5.0	0	16.0	551	23.0	60.0	1.0	84.0	2,893
9	1. V	T.Y.	23 y	12(-)	15(-)	8,500	32	2,720	6.5	9.5	0	16.0	435	10.5	60.0	8.5	84.0	2,285
10	14. "	T.T.	38 y	12(-)	14(-)	8,100	38	3,078	2.0	16.0	0	18.0	554	9.0	63.0	10.0	84.0	2,524
11	18. "	U.O.	24 y	14(-)	14(-)	10,000	28	2,800	3.0	14.0	0	17.0	479	7.0	71.0	5.0	83.0	2,321
12	7. VI	H.S.	30 y	16(-)	16(-)	9,700	16	1,552	2.5	10.5	1.0	14.0	217	8.0	67.0	11.0	86.0	1,335
13	10. "	I.K.	26 y	16(-)	16(-)	6,400	53	3,392	2.0	14.0	0	16.0	542	3.5	76.5	4.0	84.0	2,850
14	5. VII	H.A.	25 y	12(-)	15(-)	7,300	26	1,898	4.0	12.0	0	16.0	304	10.0	73.0	1.0	84.0	1,594
15	26. "	T.H.	27 y	8(-)	15(±)	7,000	27	2,590	4.0	7.0	1.0	12.0	311	11.0	72.0	5.0	88.0	2,279
16	15. VIII	A.G.	31 y	14(-)	8(-)	6,600	36	2,376	8.0	5.5	0	13.5	321	12.5	69.0	5.0	86.5	2,055
17	19. "	H.I.	28 y	11(-)	13(-)	9,900	17	1,693	1.0	3.0	0	14.0	237	5.0	77.0	4.0	86.0	1,456
18	22. "	S.H.	24 y	12(-)	4(-)	8,000	16	1,280	6.0	7.0	1.0	14.0	179	12.0	68.0	6.0	86.0	1,101
19	23. "	B.M.	29 y	11(-)	16(-)	5,900	37	2,183	4.0	12.0	0	16.0	349	8.0	75.0	1.0	84.0	1,834
20	31. "	O.O.	32 y	16(-)	16(-)	5,400	44	2,376	6.0	10.0	0	16.0	381	14.0	67.0	3.0	84.0	1,995

TABLE 6. (Continued.)

Case No.	Datum	Name	Age (y=years)	Arakawa's reaction		White blood cells per cmm.	Lym-phocytes		Lymphocytes with azurophil granules					Lymphocytes without azurophil granules					Remarks
				Right	Left		%	Absolute number	Large %	Middle-sized %	Small %	Total sum %	Absolute number	Large %	Middle-sized %	Small %	Total sum %	Absolute number	
21	11. IX	T.S.	29 y	7(-)	16(-)	6,000	48	2,880	7.0	8.0	0	15.0	432	11.0	71.0	2.0	85.0	2,448	
22	14. "	B.H.	31 y	15(-)	11(-)	6,300	45	2,835	4.5	12.5	0	17.0	482	8.0	69.0	5.5	83.0	2,353	
23	20. "	C.K.	31 y	16(-)	15(±)	7,000	47	3,290	3.0	10.0	0	13.0	428	7.0	80.0	0	87.0	2,860	§
24	22. "	T.A.	28 y	16(-)	16(-)	5,700	36	2,002	0	11.0	0	11.0	226	5.0	79.0	5.0	89.0	1,826	
25	25. "	I. S.	25 y	16(-)	16(-)	6,900	37	2,553	6.0	7.0	0	13.0	332	14.0	72.0	1.0	87.0	2,221	
26	26. "	A.H.	28 y	16(-)	8(-)	5,800	42	2,436	3.0	7.0	0	10.0	244	15.0	68.0	7.0	90.0	2,192	
27	27. "	T.K.	30 y	8(-)	8(-)	6,500	40	2,600	8.0	8.0	0	16.0	416	6.0	69.0	9.0	84.0	2,184	§
28	2. X	K.K.	27 y	15(-)	16(-)	6,800	55	3,740	5.0	8.0	0	13.0	486	13.0	71.0	3.0	87.0	3,254	
29	5. "	M.H.	30 y	16(-)	16(-)	7,200	33	2,376	4.0	10.0	0	14.0	333	14.0	71.0	1.0	86.0	2,043	
30	5. "	T.T.	25 y	12(-)	16(-)	5,600	34	1,904	4.0	7.0	0	11.0	209	17.0	70.0	2.0	89.0	1,695	
31	7. "	I. S.	24 y	8(-)	16(-)	8,900	50	4,450	7.0	6.0	0	13.0	578	10.0	74.0	3.0	87.0	3,872	
32	10. "	T.T.	20 y	16(-)	16(-)	8,600	38	3,268	4.0	8.0	1.0	13.0	425	15.0	68.0	4.0	87.0	2,843	
33	12. "	C.T.	23 y	15(-)	14(-)	9,600	50	4,500	3.0	9.0	1.0	13.0	585	16.0	64.0	7.0	87.0	3,915	
Average						7,600		2,592				14.6	378						
Maximum						10,500		4,500				18.0	585						
Minimum						5,400		1,280				10.0	179						

§ Cf. Foot-note to Table 4.

1. White blood cells (Cf. Table 7).

As will be seen from Table 7, about half of all the cases of each group showed a leucocytosis, and the reaction of the group was the weaker, the severer the grade of leucocytosis was.

TABLE 7.

Distribution of cases of each group according to different leucocyte counts.

Leucocyte count per cmm.	Normally or strongly Arakawa-positive group (68 cases)	Weakly Arakawa-positive group (100 cases)	Completely or almost completely Arakawa-negative group (33 cases)
4,000			
5,000	4% (3 cases)	2% (2 cases)	0% (No case)
(Normal) 5,000			
7,000	56% (37 cases)	33% (33 cases)	46% (15 cases)
7,000			
8,000	40% (28 cases)	31% (31 cases)	12% (4 cases)
8,000			
9,000			
9,000			
10,000			
10,000			
11,000	65% (65 cases)	54% (18 cases)	27% (9 ")
11,000			
Above 11,000	40% (28 cases)	65% (65 cases)	54% (18 cases)
Above 11,000			
	12% (8 cases)	31% (31 cases)	12% (4 cases)
	16 " (11 ")	16 " (16 ")	27 " (9 ")
	7 " (5 ")	10 " (10 ")	12 " (4 ")
	4 " (3 ")	7 " (7 ")	3 " (1 case)
	1 " (1 case)	1 " (1 case)	0 " (no case)

2. Lymphocytes (Cf. Tables 8, 9, 10, 11 and 12).

As has been shown in Table 8, 81% (55 cases) of all the 68 cases belonging to the Arakawa-positive group showed a lymphocytosis, 83% (83 cases) of all the 100 cases belonging to the weakly Arakawa-positive group and 88% (29 cases) of all the 33 cases belonging to the Arakawa-negative group showed a remarkable increase of lymphocyte count. If one glances at Table 8, then one will at once notice that the grade of lymphocytosis is the severer, the weaker the reaction of the group is. It is to be noted here that there are cases corresponding to 3% below the count 1,300 (the lowest value of normal lymphocyte count) in each group.

TABLE 8.

Distribution of cases of each group according to different lymphocytes counts.

Absolute count of lymphocytes per cum.	Normally or strongly Arakawa-positive group (68 cases)	Weakly Arakawa-positive group (100 cases)	Completely or almost completely Arakawa-negative group (33 cases)
Below 1,300	3% (2 cases)	3% (3 cases)	3% (1 case)
(Normal) 1,300 - 1,800	16% (11 cases)	14% (14 cases)	9% (3 cases)
1,800 - 3,000	81% (55 cases)	83% (83 cases)	88% (29 cases)
3,000 - 4,000			
4,000 - 5,000			
5,000 - 6,000			
6,000 -			
	49% (33 cases)	53% (53 cases)	64% (21 cases)
	22 " (15 ")	22 " (53 ")	18 " (6 ")
	10 " (7 ")	7 " (7 ")	6 " (2 ")
	0 " (no case)	1 " (1 case)	0 " (no case)

TABLE 9.

Distribution of lactating women with different Arakawa's reaction according to the percentage of lymphocytes with azurophil granules.

Percentage of lymphocytes with azurophil granules		10-15%	16-20%	21-25%	26-30%	Over 31%
Percentage of case	Healthy persons (mostly adults, lactating women excepted)	0% (0 case)	0% (0 case)	40% (12 cases)	50% (15 cases)	10% (3 cases)
	Positive cases	0% (0 case)	0% (0 case)	0% (0 case)	62% (42 cases)	38% (26 cases)
	Intermediate cases	6% (6 cases)	65% (65 cases)	29% (29 cases)	0% (0 case)	0% (0 case)
	Negative cases	58% (19 cases)	42% (14 cases)	0% (0 case)	0% (0 cases)	0% (0 case)

TABLE 10.

Distribution of cases of each group according to different lymphocyte count with azurophil granules.

Absolute count of lymphocytes with azurophil granules per cum.	Group of lactating women		
	Normally or strongly Arakawa-positive group (68 cases)	Weakly Arakawa-positive group (100 cases)	Completely or almost completely Arakawa-negative group (33 cases)
Below 300	1% (1 case)	9% (9 cases)	24% (8 cases)
300 600	36% (20 cases)	66% (66 cases)	76% (25 cases)
600 800	25% (17 cases)	20% (20 cases)	0% (no case)
800 1,000	22% (15 cases)	4% (4 cases)	0% (no case)
Above 1,000	22% (15 cases)	1% (1 case)	0% (no case)

TABLE 11.

The ratio: $\frac{\text{Lymphocytes with azurophil granules}}{\text{Lymphocytes without azurophil granules}}$

	Maximum, minimum and average	Ratio		
		Large	Middle-sized	Small
Normally or strongly Arakawa-positive group	Maximum	1.0	0.6	0.6
	Minimum	0.3	0.3	0
	Average	0.7	0.4	0.1
Weakly Arakawa-positive group	Maximum	0.9	0.7	0.5
	Minimum	0.2	0.1	0
	Average	0.5	0.2	0.1
Completely or almost completely Arakawa-negative group	Maximum	0.8	0.3	0.3
	Minimum	0	0.1	0
	Average	0.5	0.1	0

TABLE 12.

Classification of lymphocytes in lactating women with different Arakawa's reaction according to the size of the cells.

	Maximum, minimum and average	Classification (%)		
		Large	Middle-sized	Small
Normally or strongly Arakawa-positive group	Maximum	39.0	91.0	13.0
	Minimum	5.0	56.0	0
	Average	16.0	80.0	4.0
Weakly Arakawa-positive group	Maximum	38.0	94.0	15.0
	Minimum	6.0	59.0	0
	Average	17.0	79.0	4.0
Completely or almost completely Arakawa-negative group	Maximum	34.0	90.5	15.0
	Minimum	5.0	64.0	0
	Average	17.0	78.0	5.0

The Arakawa-positive group was tabulated in Table 4, the weakly Arakawa-positive group in Table 5 and the Arakawa-negative group in Table 6. In Table 3, the percentage of azurophil granules of lymphocytes was tabulated according to different Arakawa's reaction, and moreover, in Table 10, lymphocytes with azurophil granules were divided into 5 groups according to different counts.

a. Distribution of lymphocytes with azurophil granules in lactating women with different Arakawa's reaction (Cf. Table 3).

As to total percentage of lymphocytes with azurophil granules, it was 30.5% in the Arakawa-positive group, a percentage higher than in the group of healthy persons, 19% in the weakly Arakawa-positive group and 14.6% in the Arakawa-negative group respectively. As Arakawa's reaction became weaker, lymphocytes with azurophil granules decreased remarkably, so that the percentage (14.6%) in the Arakawa-negative group was just half as large as that (30.5%) in the Arakawa-positive group.

b. Distribution of lactating women with different Arakawa's reaction according to the percentage of lymphocytes with azurophil granules (Cf. Table 9).

Note the figures printed in Gothic in Table 9.

One will notice that lymphocytes with azurophil granules became smaller in percentage as Arakawa's reaction became weaker, and in the Arakawa-positive cases those with the higher percentage (the column: Over 31% in Table 9) showed a higher figure than in the case of healthy persons. Lymphocytes with azurophil granules of the percentage 21-25% (Cf. the column: 21-25% in Table 9) were not seen in the former cases, while they were seen in 12 cases (40%) of all the cases in the latter ones.

c. Distribution of cases of each group according to different lymphocyte counts with azurophil granules (Cf. Table 10).

In my own investigation, absolute count of lymphocytes with azurophil granules was 300-600 in the majority of cases of each of the weakly Arakawa-positive and the completely Arakawa-negative group, and in 30% (the highest percentage) in the normally or strongly Arakawa-positive group. I found the case with an increase over 600 in absolute count as Arakawa's reaction became stronger. In the Arakawa-positive cases, there were 15 cases (22%) with an increase over 1,000 in absolute count, and 1 case (1%) in the weakly Arakawa-positive group. However, in the Arakawa-negative group, there was not a single case even with a larger count than 600 in absolute number,

while in this group there were 8 cases (24%) with a count below 300 in absolute number.

d. The ratio of lymphocytes with azurophil granules to the ones without them (Cf. Table 11).

As to large lymphocytes, the ratio was the largest in the normally or strongly Arakawa-positive group among the three groups, while in the weakly Arakawa-positive and -negative groups the ratio was equal. Of middle-sized and small lymphocytes, the ratio decreased gradually according as Arakawa's reaction became weaker. It is needless to say that in all the groups the ratio was the largest in the case of large lymphocytes and the smallest in the case of small lymphocytes.

e. Classification of lymphocytes in lactating women with different Arakawa's reaction according to the size of cells (Cf. Table 12).

I obtained, on the whole, the ratio—large: middle-sized: small—4: 20: 1—in each group. Concerning the size of lymphocytes, there is no remarkable difference of percentage among the three groups of different Arakawa's reaction, as can be verified from the figures printed in Gothic in Table 12.

Comment.

It was reported by a number of authors that lymphocytosis occurs in cases of beriberi. Ido¹⁵⁾ saw a relative and absolute lymphocytosis, and Kubo¹⁶⁾ a relative lymphocytosis in adult cases of beriberi. And Nakamura¹⁷⁾, Sarai¹⁸⁾ and Iijima¹⁹⁾ stated that lymphocytes showed an increase, then a decrease in cases of beriberi. In our Laboratory Kokubo¹²⁾¹³⁾ studied the blood picture of normal lactating women and obtained the above described results (Cf. 71st¹²⁾ Report of the Peroxidase Reaction and 25th Hematological Paper). It was reported in a preceding paper²⁰⁾ (Cf. 149th Report of same) of my own that lymphocytosis occurred in cases of lactating mothers suffering from beriberi.

All the results of the investigations from this Laboratory have led us to conclude that "healthy" lactating women with no complaint who secrete milk strongly or normally positive to Arakawa's reaction, most of them at least, should be considered as normal or at least not

15) Y. Ido, Fukuoka Ikadaigaku Zassi, 1912, 6, 217.

16) T. Kubo, Tokyo Iji Shinshi, 1921, No. 2237, 1417.

17) M. Nakamura, Nippon Naikagakukwai Zassi, 1925, 15, 319.

18) S. Sarai, Rinsho Byorigaku Ketsueki-gaku Zassi, 1934, 3, 626.

19) R. Iijima, Ibid., 1935, 4, 531.

20) S. Watanabe, Tohoku J. Exp. Med., 1941, 40, 261.

suffering from B-avitaminosis, and that, on the other hand, "healthy" mothers with Arakawa-negative milk are generally on the verge or already in a state of B-avitaminosis. In this comment, I wish to emphasize two points: 1. The percentage of lymphocytes with azurophil granules in cases of healthy persons, and 2. the relation between those of lactating women and their Arakawa's reaction.

A survey in the results of many authors shows us that lymphocytes with azurophil granules are always seen in healthy persons, though the number is not large. The normal count of lymphocytes with azurophil granules is different according to authors.

Michaelis and Wolff²¹⁾ reported that lymphocytes with azurophil granules were present in one third of all lymphocytes by use of Romanowski-Ziemann-Nocht's method. Arneth and Stahl²²⁾ stated that they were scanty and of 10%. Kato²³⁾ and Kamiya²⁴⁾ reported a higher percentage: 32.5%* and 26.8% respectively. According to Nakanishi²⁵⁾, they were averagely of 27.4% in men and of 25.6% in women. Naegeli²⁶⁾ stated that they were present in one third of all lymphocytes at the highest, though they were usually scanty. As to the ratio of lymphocytes without and with azurophil granules, Tataru²⁷⁾ reported the ratio to be 5:1 and Arakawa²⁸⁾ to be from 14.1 to 14.9 on an average in healthy persons.

I shall not go into details here, though there are a number of studies and opinions concerning the origin of azurophil granules. I shall pick up only a few representative theories.

Pappenheim²⁹⁾ started that azurophil granules were the remnants of nuclei taken in protoplasm of cells, while Hertz³⁰⁾ formed an opinion that the dye adhered to the protoplasm accidentally when lymphocytes were stained.

Michaelis and Wolff²¹⁾ were of opinion that azurophil granules were degenerative ones.

Arneth and Stahl³¹⁾ maintained that they were related to condi-

21) L. Michaelis and A. Wolff, *Dtsch. med. Wschr.*, 1901, **27**, 651.

* Calculated by myself.

22) J. Arneth and F. Stahl, *Münch. med. Wschr.*, 1922, 963.

23) K. Kato, *Rinsho Byorigaku Ketsueki-gaku Zassi*, 1933, **2**, 1001.

24) Kamiya, *Ibid.*, 1937, **6**, 9.

25) M. Nakanishi, *Ibid.*, 1933, **2**, 989.

26) O. Naegeli, *Blutkrankheiten und Blutdiagnostik*, Berlin 1931.

27) M. Tataru, *Tokyo Igakukwai Zassi*, 1921, **34**, 641.

28) K. Arakawa, *Aichi Igakukwai Zassi*, 1924, **30**, 999.

29) A. Pappenheim, *Fol. Haematol.*, 1910, **9**, 553.

30) R. Hertz, *Ibid.*, 1913, **15**, 153.

31) J. Arneth and J. Stahl, *Z. klin. Med.*, 1922, **95**, 201.

tions of the function of lymphocytes, and that the occurrence of those meant an increase of the function of the cells. Nakanishi²⁵⁾ was also of the same opinion.

Furukawa¹⁴⁾ described that azurophil granules indicated a symbol of regenerative change of lymphocytes, that they appeared in a higher percentage in large lymphocytes and that they decreased considerably as the size of cells became smaller, adding that there were only a few small lymphocytes with azurophil granules. It is significant to note that lymphocytes with azurophil granules were of 15.5%* in adult cases of beriberi according to his result.

From these opinions above mentioned, it may be assumed that a decrease of azurophil granules below the normal limits shows that the organism is in a pathological or abnormal state. It is interesting to me that lymphocytes with azurophil granules show a marked decrease according to the weakness of Arakawa's reaction.

In my investigation, lymphocytes with azurophil granules were 26.3% in healthy persons. This is very similar to Nakanishi's²⁵⁾ and Kamiya's²⁴⁾ results. It is very characteristic that a higher percentage of those (30.5%) was seen in normal lactating women with Arakawa-positive milk in contrast to healthy persons, which fact will show that there is a certain difference between healthy non-lactating women and healthy lactating women concerning azurophil granules as well as lymphocyte count. Besides, in the weakly Arakawa-positive group, lymphocytes with azurophil granules were 19%, and 14.6% in the Arakawa-negative group. From the above related fact, it can be said that lactating women secreting milk negative to Arakawa's reaction or even weakly positive to Arakawa's reaction are in an abnormal state from the stand-point of azurophil granules, which is probably a sign of B-avitaminosis. Finally, it must be noted especially that the percentage of lymphocytes with azurophil granules in lactating women belonging to Arakawa-negative group was almost the same, as shown by Furukawa¹⁴⁾ in adult cases of beriberi.

It is not difficult to presume that the percentage of azurophil granules will thus change through an administration of vitamin B. I shall be able to report on this problem in the near future.

Summary.

1. Lymphocytes with azurophil granules were 26.3% on an average in the cases of healthy persons.

* Calculated by myself.

2. Based on the result of investigation in 201 "healthy" lactating women, lymphocytes with azurophil granules were 30.5%, 19% and 14.6% on an average in the Arakawa-positive, the weakly Arakawa-positive and the Arakawa-negative group respectively.

3. Lymphocytes with azurophil granules showed a higher count in the Arakawa-positive group than in healthy non-lactating women.

4. Lymphocytes with azurophil granules were seen in ever smaller percentages according to the weakness of Arakawa's reaction: The completely Arakawa-negative women showed even a smaller percentage of the lymphocytes with azurophil granules than the weakly Arakawa-positive women.

5. Cases in which lymphocytes with azurophil granules showed an absolute count over 600 were 69% of all the cases belonging to the Arakawa-positive group, were 25% of all the cases belonging to the weakly Arakawa-positive group, and 0% in the Arakawa-negative group.

6. As to the occurrence of azurophil granules in different-sized lymphocytes; large lymphocytes were the highest in percentage and middle-sized lymphocytes the next highest. There were only a few or almost no small lymphocytes with azurophil granules.

Conclusions.

Lymphocytes with azurophil granules in lactating women with milk positive to Arakawa's reaction showed a higher percentage than in healthy non-lactating women. They decreased remarkably according to the weakness of Arakawa's reaction of lactating mothers. So lactating women secreting milk negative to Arakawa's reaction were, from the view point of azurophil granules, in a pathological state probably due to B-avitaminosis.